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ABSTRACT

This research brief examines the potential of technology to further the goals of restructuring U.S. schools. Strategies are presented for restructuring schools with technology. Although restructuring means different things to different people, the restructuring movement has generally focused on reorganizing school processes, taking a constructivist and cognitive view of learning, and moving toward a well-integrated use of technology in the schools. Technology by itself cannot restructure schools, but it has an essential role to play in boosting educational productivity. A strategy for introducing technology in the schools could be based on principles of: (1) planning; (2) curriculum; (3) instruction; (4) access to computers; (5) teacher support; (6) effectiveness; (7) connectivity; and (8) phasing in the activities. Two specific models for the use of educational technology are the Apple Classrooms of Tomorrow program and the Integrated Technology Classroom of the Bellevue School District (Washington). Several other applications, including some in urban schools, are described, using data from the Metropolitan Educational Research Consortium files. (SLD)

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Research Brief #10

MERC

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

RESTRUCTURING SCHOOLS WITH TECHNOLOGY

"If you always do what you've always done, you'll always get what you always got."

(Unknown)

ED 411 362

The purpose of this research brief is to examine the potential of technology to further the goals of restructuring America's schools. The brief begins with a description of what restructuring means, then discusses the potential of linking technology and restructuring, and ends with strategies for restructuring schools with technology.

Why restructure?

The traditional model of education has been under constant attack. Al Shanker summarized the charge as: "The rigid and confining structure of the traditional model of education...does not enable even the majority of our children to be educated — and it never did.... [O]ur persistent educational crisis shows that we've reached the limits of our traditional model of education" (Shanker, 1992).

What has the restructuring movement concentrated on?

Three agendas of the educational reform movement have been promoted in the literature: 1) a push on reorganizing school processes, 2) a constructivist and cognitive/information processing view of learning and the effect of this view on teaching, and 3) a movement towards well-integrated uses of technology in the school curriculum (Sheingold, 1991; Bagley & Hunter, 1992).

What are the characteristics of restructuring schools?

Restructuring, means different things to different people. In fact discussion of restructuring is difficult because there has been little agreement in the definition of the word. Several generally agreed on concepts help us understand the characteristics restructuring schools have adopted. For example, schools which are restructuring:

- provide a learner-centered environment that goes beyond lecture and textbooks.
- promote the belief that learning is more than assimilating knowledge; it is constructing it.
- are between two educational paradigms and two organizational paradigms. On the one hand, they are reexamining the content and method of instruction, and at the same time they are attempting to democratize decision-making in the school, flatten the hierarchy, improve communications and share the responsibilities among all the stakeholders. (Sheingold, 1991; Newmann, 1993).

Table 1, Paradigms of Teaching, highlights the traditional and restructuring visions of schools, and draws our attention to the educational direction restructuring schools are taking.

Table I: PARADIGMS OF TEACHING

CONCEPT	TEACHER-CENTERED	LEARNER-CENTERED
Knowledge	Transferred from faculty to students	Jointly constructed by students & faculty
Students	Passive vessel to be filled by faculty's knowledge	Active constructor, discoverer, transformer of own knowledge
Faculty Purpose	Classify and sort students	Develop student's competencies & talents
Relationships	Impersonal relationships among students & between faculty & students	Personal transaction among students & between faculty & students
Context	Competitive Individualistic	Cooperative classroom learning & cooperative faculty teams
Assumption	Any expert can teach	Teaching is complex and requires considerable training

(Bagley & Hunter, 1992)

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Can technology restructure schools and schooling?

Technology by itself cannot restructure schools; however, most observers agree that schools cannot reach excellence for all children without it. The conclusion drawn by many is that technology has an essential — though not independent — role to play in boosting educational productivity (Perelman, 1987; Sheingold, 1991; and Newmann, 1993).

Then what is the role of technology?

The role of technology in the support of restructuring is evolving. Technology can be a catalyst for systemic change or it can support such change. Technology can support either the traditional school model or the restructuring model.

Technology supports traditional models by standardizing and automating procedures. Applications such as CAI, mastery learning curriculum, and programmed skill packages make existing practice better. Only certain learning tasks can be routinized. "Promoting the wholesale use of learning technologies for these purposes, such as breaking computation into sets of step by step procedures and packaging them as discrete lessons to be mastered, would mean schools would settle for the lowest level of instruction, having students learn superficial information" (Perelman, 1987).

On the other hand, there is a growing consensus that any major investment of time and effort in technology can only be justified if teachers use the technologies as tools in ways that emphasize application, word processing, simulation and program problem-solving (Cleborne Maddan, preface to Robyler et al., 1988).

Lewis Perelman (1987) adds "...merely injecting electronic tools into classrooms, while leaving the basic design of education systems unaltered offers little hope for the major improvements in educational productivity that a nation 'at risk' requires...technological change and social change are interdependent and inseparable."

Is the link between technology and restructuring real?

Comparing lofty ideals with reality can be discouraging. A majority of schools have some technologies in place and are expanding each year, but few are engaged in any organized planning or understanding of their purposes. While the number of restructuring schools is growing, schools which are restructuring are at very different places in implementing the technology. Only a few think about how technology might support their change efforts. They use technology, but few use it to support organizational and educational changes required by their visions (Perelman, 1988). The findings of several studies agree with Perelman's contention.

For example, Becker (1991) found in his national surveys that although the notion of computers being an intellectually empowering tool is growing in support, actual practice lags far behind. In a study of 31 schools, he found that even when supplied with sophisticated computer equipment and provided with abundant resources, teachers implemented a fairly traditional program of instruction "not very different than would have been followed without the computers."

Ray's (1991) study of 14 schools concluded that currently technology is an add-on to existing instructional practices. "Although the many uses of technology observed in these schools where congruent with the directives of restructuring, most educators interviewed could not describe or articulate how technology relates to their restructuring efforts." The belief, that technology is important comes from a deeper, intuitive level. Its potential to change practice is largely unfilled.

Pisapia (1993), in a study of four technology intensive schools, found that teachers continued to use technology in traditional ways. On a positive note, there was some evidence that when provided with technology rich environments, teachers progress through stages, from using drill and practice to using technology as tools.

What would a school restructuring with technology look like?

In the classrooms, teachers create **Learner Centered Environments** which are flexible and activity based. They actively engage learners in the construction of their own knowledge and understanding of facts, processes and concepts. This learning is supported by a process orientation rather than a skill orientation.

The student is an active learner. The teacher is facilitator, counselor, research associate, mentor and resource person. Instruction changes to team teaching to support interdisciplinary curricular efforts. Cooperative learning, peer-learning and sharing of ideas replaces isolationism.

In the school, block scheduling replaces standard fixed periods. There is increased parental and community involvement. The administration emphasizes a continuous process of renewal, reassessment and readjustment. Decisions are shared (Vision: Test, 1990).

In the school, technology supports the concepts undergirding the learner-centered environment by emphasizing:

- **higher order thinking skills** through simulation, problem-solving and tools application and state of the art media centers to learn research skills;
- **a past, present, future focus** through simulation, scenario construction and historical time lines;
- **a whole person focus** through video reports/presentations, computer/video interface, musical composition and desktop publishing;
- **general education** through keyboarding skill development, computer literary applications and programming;
- **multi-disciplinary education** through coursework such as the Voyage of Mimi, problem-solving software;
- **collaboration** through cooperative products such as Discourse;
- **communication and information processing** through word processing, graphics, hypermedia presentation; backbone networks for E-Mail, information transfer, television broadcasting, voice mail, links with home; state of the art libraries with networked data bases;
- **global orientation** through Kidsnet, AppleLink, Apple's global series and teleconferencing, and distance learning;
- **human values** through debates about intellectual property and equity;
- **active learning** through use of productivity tools and interactive learning technologies;
- **service learning** through desktop publishing, graphics and arts;
- **life-long learning/learning to learn** through creating information centers to support research and inquiry and computer literacy;
- **personalized learning** through ILSs;
- **process and inquiry approaches** through productivity tools and probe-ware;
- **master apprentice approaches** through the database of masters;
- **shared decision-making** through access to databases and E-mail networks;
- **parental involvement** through voice mail links, computer sharing, Talkline. (Ray, 1991a,b; Schofield & Verban, 1988).

What factors should we consider restructuring with technology?

An effective strategy must address schools as total systems and include organization, management and human resources in the agenda for innovation (Perelman, 1988). Several strategies are available which can help make the connection between technology and restructuring schools.

First, recognize that when you infuse technology, it alters the power relationships between student and teacher, among school personnel, and between the school and its environment are altered. For example, technology can introduce uncertainty in student-teacher interaction patterns. Larry Cuban (1986) observes that "policy makers too often forget that classroom learning is anchored in the emotional lives of thirty children and one teacher together for large chunks of time in small crowded places. Teachers gain pleasure from the emotional circuitry that develops between them and certain students." He notes that introducing computers to tutor and drill children can dry up emotional ties.

Second, teachers adopt innovations in light of their own goals, their accustomed practice, the culture of their community and school, and their own interpretations of the information they receive about new approaches (Betterman & Mclaughlin, 1977; Goodlad, 1984, cited in Wiske et al., 1988). Therefore, rather than add technology to an overflowing plate, it is appropriate to seek ways technology can support the directions schools have already identified (Ray, 1992).

Third, there seems to be a natural progression in teacher use of technology. As teachers become more familiar with technology, they use it less for drill and practice and more for word processing and databases. Restructuring schools can use this natural progression by first changing the way people think about teaching and learning, and then applying technology. Then, they can organize for it, put technology into the hands of teachers, integrate it into the curriculum, allow experimentation by teachers, provide adequate time to learn and develop, provide sufficient amounts of hardware, keep success stories in front of teachers and remove the classroom from isolation, and after teachers have reached a comfort level with the technology, infer knowledge about possible uses.

Finally, understand that while infusion of technology in schools is not a linear process, there do seem to be some stages that precede others. Looking at the stages from a school system perspective, Alfred Bork (1990) has described three stages that are summarized as follows:

THE BEGINNING STAGE

- Let's get lots of hardware
- Let's teach languages
- Let's teach computer literacy
- Let's train the teachers

NEXT STAGES

- Let's use advanced hardware
- Let's develop small programs for use in standard courses
- Let's use authoring systems
- Let's catalog existing software
- Let's evaluate the small programs
- Let's teach students about tools
- Let's use networks
- Let's develop management systems

FINAL STAGES

- Let's develop full curriculum using computers
- Let's investigate how to use future learning systems
- Let's develop new curricula
- Let's develop staged staff development programs
- Let's evaluate how successful implementation is proceeding

Are there guiding principles we can follow to develop our technology strategy?

With the previous understandings in mind, a technology strategy could be based on the following principles:

Planning. To apply technology effectively, it must be organized.

Curriculum. To permit the maximum advantage of technology, curriculum and instruction must change in major ways. Technology must be integrated into the curriculum, rather than being a supplement to the curriculum (Vision: Test, 1991).

Instruction. If teachers use computers at all, they use them in different ways. Recognizing the stage of teacher involvement is an important place to anchor strategies. For example,

Normal Computer Practice supports the traditional model. It uses computers in a less intensive and traditional manner focused on knowledge and skill acquisition (Becker, 1992).

Exemplary practice supports the restructuring model. It is based on the assumption that important academic outcomes will result from systematic and frequent use of technology applications that involve higher order thinking, such as interpreting data, reasoning, writing, solving concrete, complex real world problems and doing scientific investigations (Becker, 1992).

Optimal use of computers occurs when computers are used as the exemplary teachers use them. This assumption is based on the literature of cognitively-oriented theories and research on human learning and its application to classroom grouping of students in school settings (Chipman et al., 1985; Resnick, 1989, cited in Becker, 1992; and Idol & Jones, 1990).

Access. The first step in integrating technology into teaching is to put computers into the hands of teachers, and give teachers a chance to use it in planning their own work.

Teacher Support. Teacher support is required. It includes adequately arranged time to learn, plan, integrate and develop new curriculum, as well as access to technical support including maintenance, software and hardware recommendations and curriculum advice (Vision: Test, 1990).

Effectiveness. Nothing succeeds like success. Discuss the effect of technology on learning. Return to it time and time again. Ask whether a particular concept can be taught just as well without the use of technology.

Connectivity. Remove the classroom from isolation. Create an interactive learning environment where electronic systems are the primary information delivery system for the basics of all academic subjects, and where human resources and education are highly integrative.

Networks have tremendous potential to connect human and knowledge sharing. They facilitate sharing of data and information locally, regionally, nationally, and worldwide. The key feature of most networks is the ability of users to communicate with each other (E-mail) and to access a database.

Phasing. The pace of technology makes assimilation difficult. New technological developments often outstrip the school's readiness to adopt them. But, there seems to be

a natural progression in the use of technologies as teachers become more familiar with them.

James Lengel (1986, cited in Obynbene, 1989) has described three phases of technology assimilation in schools: in the **personal stage**, one or two enthusiastic teachers use technology effectively. During the **diffusion stage**, school districts and teachers succumb to a variety of influences to ensure that their schools have the machines and experiences everyone is talking about. And, in the **tool stage**, the computer is not used for drill and practice, it is not an object of study itself, but rather a tool for learning — one that is integrated into a classroom, like the encyclopedia and the globe, as a day to day instrument for teaching.

Are there specific models we can emulate?

The **Apple Classroom of Tomorrow** (ACOT) and the **Integrated Technology Classroom** (ITC) are two specific representations of the transformation that is occurring.

In the **ACOT** classrooms each student and each teacher has a personal computer at school, and another at home. The following description was drawn from Power on! (1988).

A computer on every desk creates a different educational environment from a room with a few machines at the back of the class or a school laboratory attended only once a week. Computer use in ACOT schools averages 50 percent of the day.

The technology is used by teachers in various ways. Teachers often gather the students around only one computer to demonstrate new software or to engage them in group activity. At other times, two or three students work together. Students also work alone on keyboarding, writing, and mathematics. Teachers manage records easily and even administer tests on the computer.

ACOT classrooms are different than conventional classrooms with a few computers. For example, the noise level is higher, but concentration, excitement and engagement is also higher. ACOT teachers rarely lecture the class, more often, they move from student to student dealing with individual problems. Both teachers and parents claim that students are more interested in school, more involved and more confident. The students are not magically transformed — they still yawn, poke their neighbors, and daydream. Yet, they say that school work is more fun, less boring or a lot easier. ACOT teachers have common experiences despite many different conditions, personalities, attitudes and levels of computer expertise. Specifically, they report that they are exhausted from the increased stress of learning new skills, evaluating software, and inventing ways of incorporating the computer into the curriculum. But they have found a new source of pride in, and enthusiasm for, their profession and are renewed by the effect of efforts on students (Herman, 1993).

The Integrated Technology Classroom (**ITC**) concept was developed in Bellevue School District (WA), by three teachers in grades four and five. The vision for the ITC centered on four beliefs:

- Preparing students for the future meant they needed to be life-long learners, excited about learning and self-directed.
- Students should have frequent opportunities to interact with computers and possibly other technology as part of their everyday lives and work.
- Students would be expected to work cooperatively and actively, constructing their own meaning and knowledge from the tasks they were involved in.
- A classroom-based (rather than a lab model) for computer use is preferred, so the learning environment is focused on problem-solving mathematics, whole language opportunities and integrated curriculum, and the computer is used as a tool.

Chris Held, one of the teachers who developed this module, believes the impact of technology can be impressive if the key supporting elements in curriculum redesign are present. If the curriculum is narrowly defined as content coverage, then all the "fancy technology" is a waste of money. A second element is the teacher's comfort in giving up control from the front of the classroom. Thirdly, there should be multi-aged grouping of students. The advantage is the teacher has students for two years and the returning upper grade students act as peer tutors for the incoming lower grade students. This element seems to work best if the teacher only teaches one curriculum (Held et al., 1991).

What other school division examples are there?

Many model technology based schools have been developed in the past five years. **MERC has available a database of 500 state-of-the-art applications (SOTA).** Several are described below and on the following page:

HUNTERDON CENTRAL HIGH SCHOOL, California

Instructional Network

- Every classroom contains a monitor, at least one

computer and a telephone; allowing instant communication to the entire campus and beyond. (They are linked fiber-optically to other institutions of learning throughout the state and beyond.) Local businesses can take advantage of the facilities for their own training needs.

- Prototype classrooms of the 21st century containing laser disks, a CD-ROM player, and general computer technology, for physics and fine arts.

Applications

- Computer aided drafting program
- Graphics packages
- Desk top publishing
- BioChem = hypercard programs to collect and analyze

Instruction

- New paradigm for instruction used in secondary schools

SATURN MIDDLE SCHOOL, Minnesota

Learner-Centered Environment

- Curriculum is process driven
- Textbooks are resources
- Many courses are project-based
- Students are encouraged to work cooperatively but may work independently if they choose
- Emphasis has shifted finding, organizing and making sense of the wealth of factual information available to today's student

Technology Role

- Technology is available; but Saturn is not technology driven
- Technology is used as tools by students and teachers in five distinct areas; individualized learning, group interaction, management and coordination of student learning, student expression, and knowledge production.

Applications

- ILS = Jostens and CCC
- Discourse System
- Flexible technology, CD ROM, on-line data base, etc.
- Student portfolio of proficiencies

TESSERACT ELEMENTARY SCHOOL, Miami, FL

Instruction

- Technology infused into curriculum
- Increased attention to individual learning styles
- Group across all grade levels
- Increased parental involvement

External Focus

- Community mentor program

Applications

- ILS = CCC
- Discourse LAB

INDIANA CREEL ELEMENTARY, Indianapolis, IN

Instruction

- Thematic curricular approach

Support System

- No computer coordinator — the philosophy is that every teacher is knowledgeable and comfortable with technology

Networked

- Networked computer labs and classroom computers
- Linkway multimedia

External Link

- Buddy system provides students with home computers

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Answers to questions found in this research brief have been synthesized from the MERC publications listed below. To obtain a copy, please contact the MERC office.

Pisapia, J. (1993, April). Learning technologies in the classroom: Case studies of technology intensive schools. 64 pp. ($8.50)

Pisapia, J., Schlesinger, J., & Parks, A. (1993, February). Learning technologies in the classroom: Review of the literature. 213 pp. ($10.00)

Pisapia, J. & Perlman, S. (1992, December). Learning technologies in the classroom: A study of results. 134 pp. ($8.50)